

Map Unit Properties Table

Age	Map Unit (symbol)	Unit Description	Topographic Expression	Erosion Resistance	Hazards	Cultural Resources	Mineral Occurrence	Suitability for Development	Other
QUATERNARY	Alluvial deposits (Qal)	Holocene & Pleistocene. Stream- laid deposits of mud, silt, sand, & gravel; maximum thickness 10 m	Valley floodplains	Low	Flash flooding	Unknown	Potential placer deposits	Low. Located in floodplain	N/A
	Colluvium or talus (Qc)	Holocene & Pleistocene. Angular blocks & debris masking bedrock; many small deposits not shown; thickness as much as 10 m	Poorly sorted deposits at base of slopes	Variable	Unknown	None documented	None documented	Low. Unstable deposits	N/A
	Terrace gravel & alluvial fan deposits (Qt)	Pleistocene. Gravel, sand, silt soil; some higher elevation terrace deposits could be of Pliocene age; maximum thickness about 30 m	Relatively flat (terrace) or fan- shaped landforms	Variable. Some stabilization by plant roots	None documented	Unknown	Unknown	Limited exposures in memorial	Camel <i>Gigantocamelus</i> found S of Rapid City
TERTIARY	White River Group (Tw)	Oligocene & Upper Eocene. Silty claystone & poorly indurated sandstone, arkose, & conglomerate; gravel at higher elevations; thickness as much as 120 m	Not exposed in memorial	Moderate	Potential rockfall	Unknown	Unknown	Not exposed in memorial	N/A
MISSISSIPPIAN	Madison (Pahasapa) Limestone (Mp)	Lower Mississippian. Mainly thick- bedded dolomitic limestone; bluish limestone in uppermost part; includes Englewood Limestone in areas of steep terrane; thickness 80- 210 m	Not exposed in memorial	High	Rockfall	Unknown	Unknown	Not exposed in memorial	Cave (karst) features
ORDOVICIAN & CAMBRIAN	Deadwood Formation (OCd)	Lower Ordovician & Upper Cambrian. Glauconitic sandstone, shale, siltstone, & conglomerate; thickness 0- 200 m	Not exposed in memorial	Variable	Rockfall	Unknown	Unknown	Not exposed in memorial	N/A
PRECAMBRIANPROTEROZOIC (542-2500 Ma)	Harney Peak Granite (Xh)	Proterozoic. Layered granite, pegmatitic granite, & pegmatite. Leucocratic, peraluminous, plagioclase- microcline- quartz- muscovite granite. Tourmaline & biotite common, but biotite mainly in inner part of central mass. Central mass consists of hundreds of intrusions. More than 24,000 separate bodies of pegmatite & granite are known between the central mass & the line defining the outer limit of pegmatite & granite bodies. Several hundred zoned pegmatites in a peripheral zone contain deposits of feldspar, mica, beryl & other rare- element minerals. Emplacement age of $1,715 \pm 3$ Ma for the main granite based on concordant U- Pb date for monazite, but the emplacement of some pegmatite bodies may have continued for ~10 Ma.	Pinnacles & near vertical, tabular rock bodies in Needles area; forms a thick sill at Mount Rushmore National Memorial	High	Potential rockfall	Rock into which presidents' faces are sculpted	Tourmaline, biotite, feldspar, mica, beryl and other rare- element minerals such as spodumene; fractures contain groundwater	High but local areas may contain deep fractures	Famous for the 60- ft high faces of four important U.S. presidents
	Metagabbro (Xgby, Xgb)	Xgby: Early Proterozoic. Younger metagabbro. Alkalic gabbro; differentiated sill intruding quartzite & pelite; sills & dikes spatially distributed with or near shale, tuff, & volcaniclastic rock Xgb: Early Proterozoic. Amphibolite, actinolite schist, or greenstone; well foliated; sill- like bodies; at least 2 distinct types of probable different ages; not lithologically distinct.	Not exposed in memorial	High	Potential rockfall	None documented	None documented	Limited areal extent; not exposed in memorial.	Radiometric age: 1,880- 2,200 Ma
	Metagraywacke (Xgw2, Xgwi)	Early Proterozoic. Greenish- gray to grayish- tan siliceous schist. Minor chlorite, garnet, staurolite, or sillimanite in pelitic interbeds at various metamorphic grades. Originally deposited from a density, or turbidity, current (turbidite deposit) with recognizable coarse- to fine grain graded bedding (Bouma cycle). Calc- silicate ellipsoidal structures develop from carbonate- rich concretions near the garnet- metamorphic- grade boundary (isograd). Local discordances within units probably indicate penecontemporaneous slump, but a disconformity is inferred to exist in the lower part of the unit. Subunits pinch out NW of Pactola Lake. Includes part of the Precambrian Oreville Fm in Hill City 7½- minute quad. Thickness possibly as much as 2,200 m (7,200 ft). Xgw2: Metagraywacke unit 2: Middle part of unit Xgw. Pelitic parts may contain sillimanite near Harney Peak Granite. Underlies unit Xts in the Pactola Lake area; pinches out N of Hill City. Overlies unit Xqc to the SE in the Rockerville- Keystone area, where the unit may be as much as 2,000 m (6,500 ft) thick. Xgwi: Metagraywacke unit 1: Lower part of unit Xgw. Contains high metamorphic grade minerals such as sillimanite near the Harney Peak Granite. Disconformity inferred within or at the top of the unit. Maximum thickness probably about 1,500 m (4,900 ft), but pinches out or removed by erosion to the west.	Subdued topography compared to the more prominent hills and mountains of granite sills; generally vegetated with Ponderosa pine; exposed in the vicinity of the memorial's western border	Relatively high, but more easily eroded than Harney Peak Granite	None documented	Unknown	Sillimanite near the Harney Peak Granite; fractures contain groundwater resources	Schistosity and fractures may limit suitability in some sites	Fining upward sequences of sandstone to mudstone characteristic of turbidite deposition (Bouma cycles)

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PRECAMBRIAN PROTEROZOIC (542-2500 Ma)	Metamorphosed younger alkalic basalt, tuff, & volcaniclastic rocks (Xby)	Early Proterozoic. Pillowed chloritic greenstone or amphibolite, layered amphibole schist & amphibole-bearing or biotite- rich schist; lenses of massive metachert & banded siderite- metachert or cummingtonite- rich beds; maximum thickness 1,000 m (3,280 ft).	Not exposed in memorial	High	Unknown	Unknown	Sulfide minerals or graphite; cummingtonite-rich beds	Not exposed in memorial	U- Pb zircon age of 1,884±29 Ma
	Metamorphosed quartzite, debris flow conglomerate, pelite, & granite (Xqc)	Early Proterozoic. Heterogeneous metaconglomerate, & phyllite or schist; garnet-, staurolite-, andalusite-, & sillimanite- bearing at different metamorphic grades; matrix- supported metaconglomerate clasts range from quartzite to pelitic schist; lower contact unconformable or concordant with adjacent greywacke; contact inferred to be a disconformity; thickness 30- 700 m (98- 2,297 ft).	Narrow exposures near Grizzly Bear Creek & Stockade Lake, outside of memorial	High	Unknown	Unknown	Garnet, Staurolite, andalusite, sillimanite	Limited areal extent; not exposed in memorial	N/A
	Metamorphosed quartzite & pelite (Xqs)	Early Proterozoic. Interbedded quartzite, grayish- tan schist, & phyllite; massive, thick- bedded quartzite subunits; thin- bedded phyllite; sizable areas of predominantly phyllite are probable in larger fold noses; ripple- structured quartzite indicates shelf depositional environment; thickness 1,200 m (3,937 ft).	Not exposed in memorial	High	Unknown	Unknown	Unknown	Not exposed in memorial	N/A
	Metamorphosed tuff & shale (Xts)	Early Proterozoic. Phyllite & muscovite- biotite schist; andalusite, sillimanite, garnet, staurolite, or cordierite; manganese- rich garnet fine- grained metasedimentary rock, magnetite octahedra, & traces of chalcopyrite; included as part of Oreville Fm; includes increasing number of metagraywacke beds to the NE & loses distinctive identity; thickness as much as 700 m (2,297 ft).	Limited exposures in northern part of memorial	High	None documented	None documented	Andalusite, garnet, sillimanite, staurolite, or cordierite; magnetite, & traces of chalcopyrite	Limited areal extent	U- Pb zircon age of 1,883±5 Ma
	Metamorphosed black shale (Xbs2, Xbs1)	Early Proterozoic. Dark- gray biotite schist & biotite- muscovite schist. Originally carbonaceous & iron- rich black shale (now pyrite- rich), tuffaceous shale, & siltstone. Locally contains massive chert beds. Includes part of Precambrian Loues Fm, part of Oreville Fm, & units E of Grand Junction fault in Berne quad. Thickness highly variable; original thickness estimated from 610- 1,200 m (2,000 to 4,000 ft). Xbs2: Thin- bedded dark phyllite, biotite schist, or garnet schist, depending on metamorphic grade. Resembles unit Xbs1 but contains thin units of metagraywacke. Equivalent to part of Oreville Fm. Stratigraphically higher than unit Xbs1 in central Black Hills but pinches out N of Pactola Lake. Thickness as much as 700 m (2,300 ft) in the Hill City 7.5 minute quad. Xbs1: Dark, thin- bedded slate, phyllite, or schist, & local thin beds of metachert. Generally biotite- rich & contains thin garnet- rich beds at higher metamorphic grade. Graphitic & sulfide- rich locally. Equivalent to Reausaw Slate and upper part of Poorman Fm in Lead area. Interlayered with individual metabasalt flows N- NW of Pactola Lake. Thickness estimated to range from about 30 m (100 ft) to possibly 1,000 m (3,300 ft).	Limited exposures	Relatively high, but more easily eroded than Harney Peak Granite	None documented	Unknown	Garnet; graphitic & sulfide- rich locally	Limited and isolated exposures in memorial area	N/A
	Metamorphosed carbonate facies iron- formation (Xif)	Early Proterozoic. Banded metachert with ankerite & siderite, & schist; contains cummingtonite- grunerite, & garnet at higher metamorphic grade; biotite- garnet schist & lens of massive metachert; locally sulfide- rich & graphitic; present at various stratigraphic levels including both younger & older Early Proterozoic units; poor exposures are typical in areas of low metamorphic grade, & unit mapped largely on metachert float; thickness variable, average 25m (82 ft).	Limited to thin, linear exposure SE of memorial	High	Unknown	Unknown	Ankerite, siderite, cummingtonite, grunerite, garnet locally sulfide- rich	None	N/A
	Quartzite (Xeq)	Early Proterozoic. Thick- bedded, light- tan quartzite & minor meta- arkose, both grading distally to quartzose phyllite; quartzite; 500- 3,300 m (1,640- 10,827 ft) thick	Extensive exposures S of memorial	High	Rockfall	Unknown	Unknown	Not exposed in memorial	N/A